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Enhancing the Ability of Mathematics Student Problem Solving through Pembelajaran Pelangi Matematika

Diar Veni Rahayu
Program Studi Pendidikan Matematika
STKIP Garut Indonesia
diar_math@yahoo.com

Ekasatya Aldila Afriansyah
Program Studi Pendidikan Matematika
STKIP Garut Indonesia
e_satya@yahoo.com

Abstract

One of the mathematical abilities that need to be owned by junior school students is a problem solving ability. By having the ability of problem solving, the students can be a good problem solver in every field that they do later. In fact, there are many junior high school students who have not achieved a good mathematical problem solving, especially in SPLDV topic. This research aims to improve students' problem-solving ability through the application of Pembelajaran Pelangi Matematika model in SPLDV topic. This type of research is a qualitative research using descriptive analysis method, any giving of the treatment was observed through observation sheets of student activity and observation sheet of teacher activities. To know the result of the given treatment, performed the final test and questionnaire. The results obtained from this study are the application of PPM models are able to bring students into the learning situation more meaningful and enjoyable in the process of classroom learning. The strategy of grouping students homogeneously brings independence and confidence of students to solve problems encountered. The steps used by PPM model make students did not feel depressed and even tend to be enthusiastic during the learning process takes place. Enhancing mathematical problem-solving ability of students at the high category and the students have a positive attitude towards the implementation of PPM model. The conclusion from this study is that the application of PPM models can enhance mathematical problem solving ability of students, especially in the SPLDV topic.

Keywords: problem solving ability, grouping students homogeneously, pembelajaran pelangi matematika model.

1. Introduction

Mathematics has an important role in educational settings in order to achieve complete Indonesian human, the human who is able to resolve the problems encountered. Therefore mathematics lessons are given at every level of education from primary to secondary education, with the aim that every student can have the ability to solve the problems. As stated in one of the goals of learning mathematics based Kurikulum Tingkat Satuan Pendidikan (KTSP) is that students should have the ability to solve problems which includes the ability to understand the problem, devised a mathematical model, solve the model and interpret the obtained solution (see [1]).

The important role of mathematics (especially in problem solving) cannot be optimized by majority students; it is visible from some researches that say the ability of mathematical problem solving of most students is still low. In addition, there are many students who think that mathematics is a difficult and tedious subject. The author observes that the lack of mathematical problem solving capabilities and the emergence

of these assumptions as a result of unpreparedness students to follow a particular learning activity regardless of the presence of heterogeneity of students' mathematical abilities.

Heterogeneity of mathematical students ability can be classified into three groups, namely the group of students who have high ability, medium ability, and low ability. There are many researches which is found that learning is done more focused on a specific learning model which is given to all students 'mathematical abilities classification (without regard to the existence of heterogeneity of students' mathematical abilities), so it is often found that the results of studies found a good instructional model to a high ability, but not good to the medium ability and low ability, or vice versa. Not a few students who are desperate and stop his efforts to solve a mathematical problem when learning takes place because it cannot keep up with the learning activities undertaken.

These problems need to be addressed in order to realize meaningful mathematics learning for all students. One way is deemed appropriate to resolve the issue is through the application of Pembelajaran Pelangi Matematika model (PPM). PPM is a mathematical learning model that provides an opportunity for every student to perform the learning activities in accordance with its mathematical capabilities, resulting in every class applied several different types of treatment; different treatment is certainly in order to realize the learning of mathematics more meaningful for all students.

2. Study Literature

a. The Ability of Mathematical Problem Solving

The learning process of mathematics is essentially not just transfer the teachers concept or idea to students, but the process in which the teacher provides an opportunity for students to understand and construct ideas that are given for later use in solving various problems in accordance with the level of development. Based on this view, the problem-solving ability is one of the essential and fundamental skills in mathematics that should be owned by every student.

The importance of problem solving ability is stated in one of the recommendation of the National Council of Teachers of Mathematics (NCTM) is that problem solving should be the focus on the learning of mathematics at every level of school. This recommendation does not only show the importance of developing a problem-solving ability of student, but also implies that any solution must be an integral part of the mathematics curriculum (see [7]).

Mathematical problem solving as one of the aspects of high-level thinking skills, defined by Cooney (see [6]), as a process of accepting the problem and try to resolve the problem. While Polya defines problem solving as an attempt to find a way out of a difficulty, to reach a goal that is not achieved immediately. Furthermore Polya said that solving the problem is an intellectual activity level to seek solution of problems faced by using a knowledge that is already owned. (see [4])

Stanic and Kilpatrick (in [2]) states that historically there are three main roles in the learning of mathematics problem solving in schools, namely: 1) as a problem-solving context; when problem solving used as context in mathematics, the emphasis is for students interested and actively involved in solving problems that help explaining the procedure or mathematical concepts; 2) Problem solving as a skill, through problem-solving activities, students must successfully understand mathematical concepts and

procedures of mathematics; 3) Problem solving as an art, problem solving can be seen as the art of inquiry and the art of discovery.

According Sumarmo (see [6]), problem-solving ability can be specified with the following indicators: (1) identify the adequacy of the data for problem solving; (2) create a mathematical model of situation or everyday problems and solve problems; (3) select and apply strategies to solve mathematical problems and or outside mathematics; (4) Explain or interpret the results as the origin of the problem, and verify the results or answers; (5) apply mathematics meaningfully.

b. Heterogeneity of Mathematical Student Ability

NCTM recommends major concern should be given to students actively participating in constructing and applying ideas in mathematics (in [10]). The level of participation in constructing and applying mathematical ideas differ from one student to another, depending on the characteristics of the mathematical abilities of each student. These differences indicate the presence of heterogeneity of students' mathematical abilities.

Based on this, the activity of learning mathematics, especially in order to improve the ability of problem solving must consider the heterogeneity of the characteristics of students' mathematical abilities. Related characteristics of students, Sumantri (see [11]) states that individual differences in middle school students distinguished by differences in potential ability and actual ability. Potential ability is a skill contained within the students who earned the carriage, so having the opportunity to develop into an actual ability. While the actual ability is a skill that can be demonstrated and tested right now, because it is the result of effort or study concerned with the manner, and in the case of certain materials that have lived.

Mathematical problem solving ability that belong to the actual ability, the results of operations or student learning so that the learning methods and materials must be made and prepared in accordance with the characteristics of the students themselves. In [3] mentions that the students are the subject of education that should be heard, and appreciated approached comprehensively about all their hopes and aspirations. The students is a person who has the potential and ability, therefore education should be considered a fertile seedbed for developing the student as a whole. Thus, learning is done should allow every student has the opportunity to develop all their potential in accordance with the level of ability either potential ability or actual ability.

c. Pembelajaran Pelangi Matematika

Pembelajaran Pelangi Matematika (PPM) is a mathematical learning model that provides an opportunity for each student to conduct learning activities in accordance with its mathematical capabilities, resulting in every class applied to several different types of treatment, different treatment is certainly in order to realize the learning of mathematics more meaningful for all students. PPM models are very suitable for the class that has heterogeneity of high mathematical ability.

In practice, the first students in a class are grouped into three groups according to the classification of mathematical ability (high, medium, and low) were obtained based diagnostic tests. Then, all groups given Lembar Belajar Siswa (LBS) / LKS partially colored rainbow colors (red, yellow and green). Each color of LBS has different learning tasks, tiered according to the level of mathematical ability of students

ranging from simple to complex. LBS has been based on the concept of the invention which refers to Competence Standard and Basic Competence specified. Students who have not completed the learning task in a color LBS have not been allowed to work on the next color. Students who have completed all colors LBS, can help a friend who is not yet complete rainbow colors.

Learning steps on the PPM model is the result of learning adapted from contextual and based on a theory of meaningful learning that is triggered by a number of experts. Ausubel (in [3]) describes the theory of teaching and advance organizers, this theory gives an explanation of how the teacher is able to provide conditioning to student thinking in terms of managing strategy, a strategy using knowledge and skills, as well as strategies to draw conclusions in urgent circumstances when subjected to conditions of learning about something that is difficult and requires quick and appropriate decisions. This teaching theory tries to optimize student cognitive structures that grow and develop during or in the process of learning.

In practice, students will be required to select, define and classify knowledge, knowledge that they have and relevant to the demands of learning at the time. Then when the students reach a conclusion on part or all of the knowledge they have, that is the time when they should start to apply them in an effort to understand knowledge or learn to solve problems that it faces. Learning is said to be meaningful if the students learned the information prepared in accordance with the student's cognitive structure, in order to connect new knowledge with the cognitive structures owned.

Vigotsky (see [9]) says that the learning process will occur and succeed if they study learning materials are still within their reach. Vigotsky also gives emphasis on scaffolding, which means providing large amounts of aid in the form of a question when there is congestion (stagnation thinking), and then gradually reduce aid and provide the opportunity for students to take greater responsibility after he was able to do so.

In connection with the preparation of teaching materials (in this case LBS), Reilly and Lewis (in [8]) states that there are two requirements to make the subject matter meaningful for students, namely: 1) Select material that is potentially meaningful and governed in accordance with the developmental level and knowledge of the past; 2) Given the meaningful learning situations. Furthermore, it can be applied in teaching and learning through the following stages:

1. Measuring readiness of learners such as interests, abilities and cognitive structures through preliminary tests, interviews, questions and so on;
2. Select the key material, then present it begins with concrete examples and controversial;
3. Identify the principal which must be mastered from the new material;
4. Presents an overall view of what is to be learned;
5. Wearing advance organizer;
6. Inviting students understand the concepts and principles that exist by focusing on the relationships that exist.

3. Research Method

This research is qualitative research. In [5] stated that qualitative research is research to understand the phenomenon of what is experienced by research subjects such as behavior, perception, motivation, action, and other holistically and by means of

a description in the form of words and language, in a specific contexts by using various natural and scientific methods.

Subjects in this study amounted to 29 people which is a class VIII student SMPIT Wasilah Intelligence, Garut. Selection of subjects in this study used purposive technique based on the presence of heterogeneity level mathematical skills are high so that it matches with the theme of this research. The procedure of this study consists of the planning, execution, data processing and report generation.

In the planning phase of this study consisted of: 1) find a school (a research) which has the characteristics of heterogeneity of high mathematics student ability; and 2) make diagnostic tests and Kemampuan Pemecahan Masalah Matematik test (KPMM) as well as about the beginning of the end for the KPMM test. The implementation phase of this study consisted of three stages, namely: 1) diagnostic tests; 2) provision of treatment; 3) evaluation / final test and questionnaire administration. Processing of the data in this study is a data processing diagnostic test results and test the initial KPMM, observation sheet at the time of treatments, the KPMM test data, and the data filling questionnaires and interviews.

4. Research Results and Discussion

Diagnostic test in this study is a test that is performed to measure the students' mathematical ability level. The material on this test consists of questions test which is test the ability of such basic operations of integers, fractions, algebra, and linear equations of one variable. The results of the diagnostic test is used to grouping students into homogeneous groups based on the classification of High (H), Medium (M) and Low (L) ability as a setting for learning pembelajaran pelangi matematika. Based on the data analysis of diagnostic test are given in the beginning research activities, indicating that the class is a subject of the study had the mathematical skills of high heterogeneity. This is consistent with previous results of preliminary studies that have been conducted, the results of which form the subject of interviews with teachers and principals. The results of the diagnostic tests that have done can be seen in Table 1 below.

Table 1. Diagnostic Test Results

No	Student Name	Score	Group	No	Student Name	Score	Group
1	Student 1	**20**	**H**	**16**	Student 16	**10**	**M**
2	Student 2	**20**	**H**	**17**	Student 17	**10**	**M**
3	Student 3	**19**	**H**	**18**	Student 18	**10**	**M**
4	Student 4	**19**	**H**	**19**	Student 19	**10**	**M**
5	Student 5	**18**	**H**	**20**	Student 20	**9**	**L**
6	Student 6	**18**	**H**	**21**	Student 21	**8**	**L**
7	Student 8	**17**	**H**	**22**	Student 22	**8**	**L**
8	Student 9	**17**	**H**	**23**	Student 23	**8**	**L**
9	Student 10	**17**	**H**	**24**	Student 24	**6**	**L**
10	Student 11	**15**	**M**	**25**	Student 25	**5**	**L**
11	Student 12	**12**	**M**	**26**	Student 26	**5**	**L**
12	Student 12	**12**	**M**	**27**	Student 27	**5**	**L**
13	Student 13	**10**	**M**	**28**	Student 28	**4**	**L**
14	Student 14	**10**	**M**	**29**	Student 29	**3**	**L**
15	Student 15	**10**	**M**				

Learning activities designed in this study based on the steps contained in the PPM models with homogeneous grouping of students based on data from diagnostic tests mentioned above. Based on the data analysis of teachers' observations and students' observations, in general it can be concluded that the PPM models have an important role in creating meaningful learning situation and can enhance students' mathematical problem solving ability. This is supported by the presence of the treatments were carried out in accordance with the teacher models the steps that have been designed on the model of the PPM. The summary of the results of an analysis of the activity of the teacher observation sheet can be seen in Table 2 below.

Table 2. Summary of the Results of the Observation Teachers' Activities

No	Meeting	Description
1	1	In general learning steps on PPM models implemented properly, it can be seen from the 14 items that have both category, 3 category items fairly, and 2 items less category. There is one item that is not found the item "discuss homework / exercises assigned at the previous meeting" because this is the first meeting, so it does not become a mistake.
2	2	In general learning steps on PPM models implemented properly, it can be seen from the 17 items that have either category, 3 items categorized simply, one of them on the items "to check the prerequisite knowledge of students", this is because the first meeting was depth enough.
3	3	In general learning steps on PPM models implemented properly, it can be seen from the 18 items that have either category, only two items were not found, which discusses homework and provide homework; this is due to time constraints.
4	4	In general learning steps on PPM models implemented properly, it can be seen from the 19 items that have either category, and only one item that is not found discussing the homework, because at the previous meeting are not given homework.
5	5	From the introduction to the core activities, all the items made with either category, but at closing activity, there are three items that are made with less categories such as reflection and reinforcement, this is due to a rather long discussion on core activities, so that the time on the closing consumed, even the last two items could not be done, which does not provide practice questions / homework.
6	6	All the steps of learning to PPM models implemented properly, it can be seen from the 19 items that have either category and only one item is not found, it was because of the previous meeting was not given homework.

Based on the analysis of data observation sheet of student activities, the results showed that in the learning process in the classroom, learning activities using PPM models are able to bring students into the learning situation more meaningful and enjoyable. That is because the learning activities students learn according to their ability level, so it can lead students to explore and use a variety of strategies to solve problems related to its material SPLDV given. The strategy of grouping (grouping) students homogeneously is bringing independence and confidence of students to solve problems encountered. In addition, the steps used in PPM makes students did not feel depressed and even tend to be enthusiastic during the learning process takes place.

In addition, the teaching materials are produced teaching materials designed with the principles of the Rainbow (diverse, meaningful and fun) that adapted from didactic

design that have compatibility with the learning trajectory through which the students during the learning process. Starting from a simple shape-concrete that can provide a process understanding SPLDV related concepts, to the formal-abstract forms that require a high level of mathematical thinking skills. Teaching materials and the problems generated by this learning model, contains contextual issues that guide students to rediscover (reinvent) and understand basic mathematical concepts, especially the concept of SPLDV.

One of the important results in this study is the principle of the Rainbow (diverse, meaningful and fun) on SPLDV learning for heterogeneous classes. The findings in this study indicate that students can learn in a more meaningful if the teaching materials and the problems encountered in accordance with mathematical ability and track learning path.

5. Conclusion and Suggestion

a. Conslusion

Based on the research that has been described, it can be concluded that the application of Pembelajaran Pelangi Matematika in a heterogeneous class has a very important role in improving students' mathematical problem solving ability in SPLDV topic. This research has been successfully implemented and provides good impact on the learning of mathematics, particularly on learning SPLDV in the classroom which has heterogeneous mathematical ability of students, in class VIII SMPIT Wasilah Intelligence, Garut.

b. Suggestion

After doing some researches and see and feel the learning process with PPM models, and considering the above conclusions, the suggestions that can be expressed by the author are as follows: 1) for teachers, learning to PPM models can be used as an alternative to mathematics learning activities fun and varied and can be applied in heterogeneous classes in an effort to improve students' mathematical problem solving ability; 2) the development of teaching materials that contain contextual issues can be used as an example for the study of learning design, development and research with other topics of mathematics learning; 3) for the implementation of further learning, especially material related to the algebraic form or on a homogeneous class teaching materials and learning models, need to be developed.

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